

A Revision of the Fishes of the Subfamily Alfarinae in the Family Poeciliidae

DONN ERIC ROSEN

New York Aquarium, New York Zoological Society¹

(Text-figures 1-10)

WHILE examining specimens of the Costa Rican poeciliid, *Alfaro cultratus* (Regan), their strong resemblance to the related species, *Furcipenis huberi* (Fowler), was noted. A comparison of two geographical populations of *Furcipenis huberi*, collected by Dr. Myron Gordon in Honduras in 1951, with some *Alfaro cultratus* in the Museum of Zoology, University of Michigan (UMMZ 159157), suggests that the two genera are more closely related than is indicated by their present systematic positions.

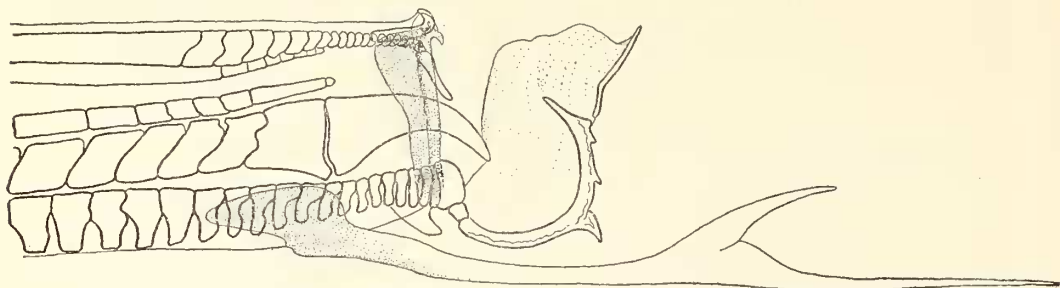
In his extensive revision of the poeciliid fishes, Regan (1913) indicated that the affinities of *Alfaro* lay with *Tomeurus*. Among other details he pointed out that both possess a keel of scales on the ventral margin of the caudal peduncle. Hubbs (1924) agreed with Regan in relating the genera *Alfaro* and *Tomeurus*, for he erected the tribes Alfarini and Tomeurini to receive them, and then included these two tribes in the subfamily Tomeurinae Eigenmann (1909). In 1926, however, Hubbs reversed his former estimate of the taxonomic positions of the alfarins and tomeurins when he discovered that the ventral keels in these two genera are not homologous. In accordance with this view, Hubbs (1926) placed the tribe Alfarini in the subfamily Poeciliinae to which he thought it bore a closer relationship, leaving the single species *Tomeurus gracilis* in the subfamily Tomeurinae. The separation of these two groups is well taken, as may be appreciated by an examination of their gonopodia (Text-figs. 1, 2).

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Furcipenis huberi was originally described by Fowler (1923) as *Priapichthys huberi* because of its superficial resemblance to *P. annectens* (Regan). Hubbs (1931) claimed, however, that *Priapichthys huberi* Fowler is more closely related to the Heterandriini, and that it possesses certain poeciliin features such as a gonopodial hood on the anterior margin of ray 3. This latter diagnosis was confirmed by Howell Rivero & Hubbs (1936), but they thought that the genera *Alfaro* and *Furcipenis* compose a compact group which should be placed apart from the poeciliins as a separate subfamily, the Alfarinae.

According to the same authors, the Alfarinae may be characterized as follows: Ventral margin of the caudal peduncle with a well-developed or incipient keel of scales. Pelvic fins relatively unspecialized in adult males. Gonopodium short; the paired halves of ray 5p either joined at the median plane of the fin or separated near the edges of an open trough formed by the flat, fused segments of ray 5a; a well-developed gonopodial hood present (see Clark & Aronson, 1951, for a description of the gonopodial hood in *Lebistes*), surrounding the anterior margin of the gonopodium below ray 3; segments of ray 3 angulated anteriorly into the base or region of attachment of the gonopodial hood; gonopodial rays without serrae. Gonopodial suspensorium simple; gonapophyses without uncinatoid processes.

To the above list may be added some additional features which distinguish the known alfarins. 1. The body is strongly compressed, with the dorsal fin origin closer to the caudal base than to the supra-occipital bone of the skull (Text-figs. 4, 5, 6). These details give the alfarin a streamlined, gambusia-like appearance. 2. The three interorbital pores of the supra-orbital canal



TEXT-FIG. 1. Distal tip of the gonopodium of *Tomeurus gracilis*. $\times 25$.

are not separated; together they form a deep furrow over the frontal (supra-orbital) bone. The postorbital pores also are confluent, forming major depressions above and slightly behind the orbit (Text-fig. 7). 3. In the gonopodium, a series of lateral wings on the outer faces of the bases of the spines extends from the fifth or ninth spine proximally to the last member of the series. Each lateral wing is perpendicular to the vertical axis of a spine and projects backward away from the tip (Text-fig. 8). Together the lateral wings form a ledge which may function as a partial support for the enlarged gonopodial hood. The gonopodial hood articulates with the two eccentric grooves on the anterior margins of ray 3. These anterior or ventral grooves are the structures that Howell Rivero & Hubbs (1936) refer to as antrorse segments. They are present in most poeciliid gonopodia but they are especially large in the alfarins (Text-figs. 2, 3, 9).

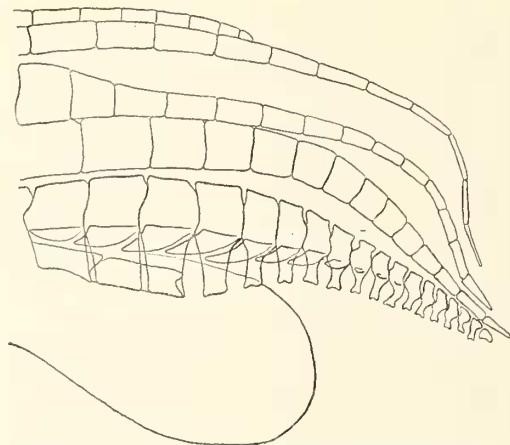
ANALYSIS OF DIFFERENCES

IN THE GENERA ALFARO AND FURCIPENIS

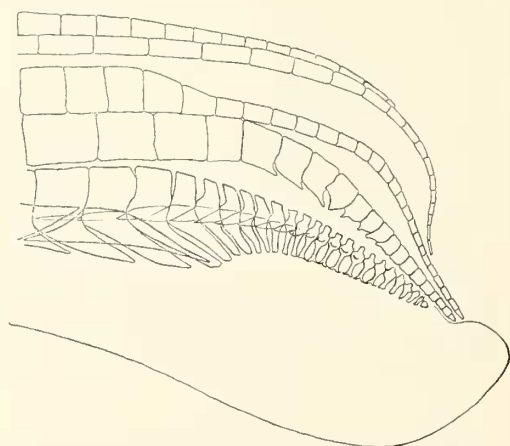
These two nominal genera share many features, as indicated above. This is especially true with reference to their general body plan and the general configurations of their gonopodial elements. But certain details (of taxonomic importance in this group) have been shown to deviate significantly.

Urosomal Keel.—The ventral margin of the caudal peduncle of *Alfaro cultratus* is strongly keeled. Meek (1912) observed that the keel in *Alfaro* is composed of a double row of scales with their inner surfaces in close apposition. Howell Rivero & Hubbs (1936) showed that the alfarin keel represents a downward extension of the ventro-lateral scales and a loss of the median scale row that normally rounds over the lower edge of the urosome. They regarded the modified squamation in *Furcipientis* merely as an incipient keel because the median scale row still persists, although pinched in between the lateral scales. In general, this is true of specimens of

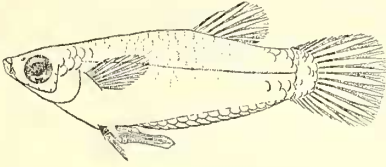
Furcipientis huberi from the inland Department of Cortez, Honduras, in which the keel is present as a slender ridge. But in the *Furcipientis* collected in the coastal Department of Atlantida, Honduras, about 10 kilometers west of Ceiba (Text-



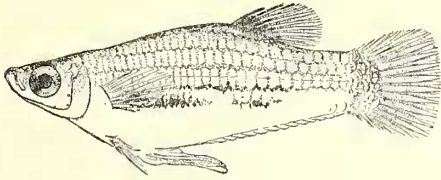
TEXT-FIG. 2. Distal tip of the gonopodium of *Alfaro cultratus*. $\times 25$.



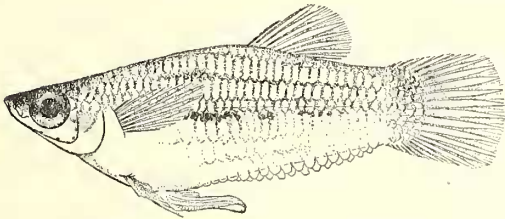
TEXT-FIG. 3. Distal tip of the gonopodium of *Alfaro huberi* (*Furcipientis huberi* as formerly constituted). $\times 25$.



TEXT-FIG. 4. Male of *Alfaro cultratus* showing position and extent of development of the urosomal keel of scales. $\times 1$.



TEXT-FIG. 5. Male of *Alfaro huberi* from inland areas of the Department of Cortez, Honduras. Note the presence of an incipient keel. $\times 1$.



TEXT-FIG. 6. Male of *Alfaro huberi* from the coastal areas of the Department of Atlantida, Honduras. Note enlarged keel with the rudimentary scales of the median row present. $\times 1$.

fig. 10), the keel is fully expressed, particularly in adult males, and the median scale row is represented by a few loose scale remnants, or is entirely lacking. The urosomal keel apparently is a poor criterion for the taxonomic separation of these two genera.

Coloration.—There are two layers of melanophores in *Furcipenis huberi*: sub-epidermal or scale melanophores and dermal melanophores. The scale melanophores are present as a fine dusting over the entire body surface and appear to be continuous in distribution with the melanophores of the fins. The dermal melanophores line the scale pockets and are deeper; they form a distinct, sharply defined reticular pattern, conforming to the outlines of the scale bases. This pattern fades abruptly and is faint below the mid-lateral line. Occasionally the dermal melanophores are grouped in a linear series forming, in addition to reticulations, one or more lateral streaks. There is usually a series of small black blotches on the belly, at the ventral margin of the

pectoral fin. The caudal fin has a smooth wash of an even gray which extends to its subdistal limits. The other fins are finely stippled.

The coloration of *Alfaro cultratus* is unlike that of *Furcipenis huberi*. There are no reticulations. Only a fine dusting of sub-epidermal melanophores is present in addition to a thin lateral streak that extends from the pectoral to the caudal base.

Gonopodium.—The gonopodium of *Alfaro cultratus* differs from that of *Furcipenis huberi* in only three very minor respects. 1. The small serrations on the anterior margin of ray 4a in the gonopodium of *Furcipenis* are not present in the gonopodium of *Alfaro*. 2. The spines of *Alfaro* are not angular proximally, while the proximal spines of *Furcipenis* are angular. The shafts of the spines of *Furcipenis* are attenuate and they overlap. 3. The gonopodial hood of *Furcipenis* is larger and extends farther out at the tip than the comparable structure in *Alfaro* (Text-figs. 2, 3).

Axial Skeleton.—According to Howell Rivero & Hubbs (1936), *Alfaro* has six caudal vertebrae which bear ribs, whereas *Furcipenis* has only four caudal vertebrae which bear ribs. They attribute this to the more advanced position of the anal fin and the greater penetration of the urosome by the air bladder in the genus *Alfaro*. Gordon & Benzer (1945) indicate that comparable variations are found among xiphophorin species, but they do not attribute special systematic importance to them.

TAXONOMIC CONCLUSIONS

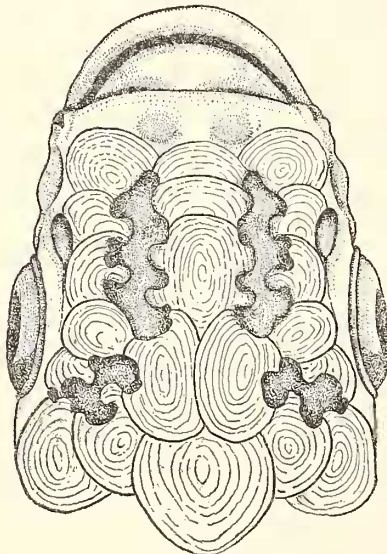
The nominal genera *Alfaro* and *Furcipenis*, of the subfamily Alfarinae, agree in most of their morphological details. This is particularly true of their genitalic elements where differences, although constant, are of an extremely minor character. Some other differences not previously mentioned are summarized in Table 1. *Alfaro* has two or three fewer dorsal fin rays and an average of two more lateral scales. But because of their extreme variability, these details have never constituted a basis for generic separation in poeciliid fishes. The most trenchant remaining argument advanced for recognizing the two genera is the circumstance that the marginal keel is incipient or small in *Furcipenis*, and prominent and well developed in *Alfaro*. The keel, however, is as strongly expressed in some geographical populations of *Furcipenis* as it is in the related *Alfaro*. Therefore the urosomal keel can no longer be regarded as critical for a comparison of the alfarin genera.

Since the two species, *A. cultratus* and *F. huberi*, differ from each other only superficially, or at most statistically, there is no justification

TABLE 1. A COMPARISON OF THE NOMINAL GENERA ALFARO AND FURCIPENIS

	<i>Furcipenis</i>	<i>Alfaro</i>
Body	Compressed	Compressed
Keel on caudal peduncle	Usually present	Always present
Dorsal origin	Closer to caudal base than to posterior margin of skull	Closer to caudal base than to posterior margin of skull
Head pores	Well developed and confluent	Well developed and confluent
Lateral scales	30 or 31	31 to 33
Dorsal fin rays	9 or 10	7
Gonopodium		
a. Serrae on ray 4a	Present	Wanting
b. Spines on ray 3	Present; proximal members angular	Present; proximal members not angular
c. Gonopodial hood	Present; large, extending to tip of fin	Present; smaller, not quite reaching to tip of fin
Coloration	Heavily reticulated; black belly blotch	No reticulations or other dark markings
Habitat	Clear, shaded, rocky streams, and lakes (Lake Yojoa, Cortez, Honduras)	Clear, shaded, rocky streams only

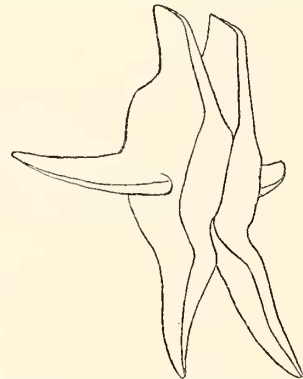
for maintaining two monotypic genera to contain them. The need of joining closely related genera follows the principles used to synonymize *Xiphophorus* and *Platypoecilus*. Gordon & Rosen (1951) and Rosen & Gordon (MS.) show that although there is a wide range and variety of differences among the seven species of the genus *Xiphophorus*, each species possesses at least several features in common with other



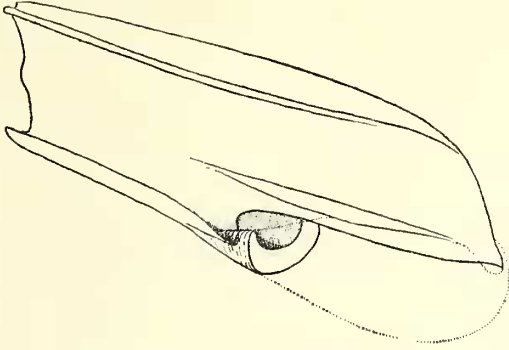
TEXT-FIG. 7. Dorsal view of the head of *Alfaro huberi* showing the position of the head pores. $\times 4$.

members of the genus. For example, four of the seven species possess a caudal appendage or sword, while six out of seven species, excluding one of the swordtails, have large, numerous, distal serrae on ray 4p of their gonopodia. In addition, Rosen & Gordon (1951) point out that there are at least five well-defined species groups within the genus *Gambusia*. Each of these groups is composed of forms with similar gonopodial details and each has a definite geographical range. Among the morphologically different species groups in the genus, there is little inter-group geographical overlap.

In conformity with present taxonomic practice, it is desirable to suppress the genus *Furci*



TEXT-FIG. 8. Diagram of the spines of ray 3 in the gonopodium of *Alfaro* showing position of lateral wings. $\times 100$.



TEXT-FIG. 9. Stereogram of the gonopodium of *Alfaro huberi* showing the position of one of the two eccentric grooves, located on the left ventrolateral surface of ray 3. The gonopodial hood has been cut at its base; its extent is indicated by the stippled line. $\times 25$.

penis. This will serve to lessen the danger of exaggerating what are in reality small differences. Assigning *A. cultratus* and *F. huberi* to the same genus will also serve to emphasize their seemingly close phylogenetic relationship. Of the two

generic terms, *Alfaro* is the older and it thereby enjoys priority in the present synonymy:

ALFARO Meek

Petalosoma Regan, Ann. Mag. Nat. Hist., (8), II, 1908, p. 462 (*P. cultratum* Regan, name pre-occupied).

Alfaro Meek, Field Mus. Nat. Hist., Zool., X, September, 1912, p. 72 (*A. acutiventralis* Meek).

Petalurichthys Regan, Ann. Mag. Nat. Hist., X, November, 1912, p. 494 (*Petalosoma cultratum* Regan; substitute for *Petalosoma*, pre-occupied).

ALFARO CULTRATUS (Regan)

Petalosoma cultratum Regan, Ann. Mag. Nat. Hist., XI, 1908, p. 458.

Alfaro acutiventralis Meek, Field Mus. Nat. Hist., Zool., X, 1912, p. 72.

ALFARO HUBERI (Fowler)

Priapichthys huberi Fowler, Proc. Acad. Nat. Sci. Phila., 75, 1923, pp. 27-28.



TEXT-FIG. 10. Distribution of the genus *Alfaro* in Central America. *Alfaro huberi* is represented by solid dots, and *Alfaro cultratus* by open circles.

Furcipenis huberi Hubbs, Univ. Mich., Mus. Zool., Occ. Pap., 230, 1931, pp.1-3.

The following key may be used as a method for the separation of these two species:

KEY TO THE ALFARIN SPECIES

- A. Gonopodial hood originating on the anterior margin of ray 3. Proximal serrae of ray 4a usually wanting (rudimentary when present). Spines of ray 3 flanked by large, horizontal lateral wings. Eccentric grooves on ray 3 large and flaring
 *Alfaro*
- B. Dark reticulations present on body above mid-lateral line. Lower edge of caudal peduncle with a well-developed or an incipient keel of scales. Spines of ray 3 of gonopodium angulated antorsely. Gonopodial hood extending out to tip of fin or slightly beyond. . . . *A. huberi*
- BB. No dark reticulations present on body; only a thin lateral streak present. Lower edge of caudal peduncle always sharply keeled. Spines on ray 3 of gonopodium always vertical. Gonopodial hood not quite reaching to tip of fin. *A. cultratus*
- AA. Gonopodial hood originating on the anterior margin of ray 3. Proximal serrae on ray 4a always present. Spines on ray 3 without lateral wings. Eccentric grooves on ray 3 small and not flaring
Mollienesis, Poecilia, Micropoecilia, Parapoecilia, Allopoecilia, Linia, Lebistes

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